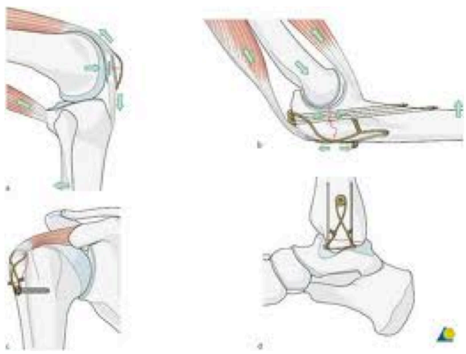
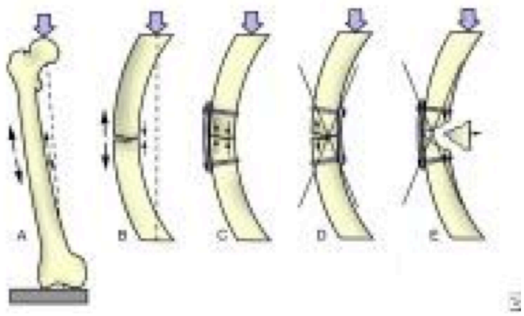
TENSION BAND WIRING [TBW]

When a curved bone subjected to an axial load always presents a tension side on the convexity and a compression side on the concavity. In the femur tensile forces are on the lateral and compression on the medial side. By applying a tension band device laterally, these tensile forces are converted to compression forces, assuming the opposite side is stable and has good contact.

In fractures where muscle pull tends to displace fragments as in the olecranon or patella a tension band wiring neutralize the distraction forces and the fragments will be compressed.

In principle, any **fixation** device, plate, wire loop, and even an external fixator, if applied correctly to the tension of a fractured bone, can act as a tension band. The tension band device must withstand





tensile forces, the bone must resist compressive forces, and the cortex opposite to the tension band should be intact.

PLATE FIXATION

There are five key functions or modes any plate can have:

1. Neutralization or protection
2. Compression
3. Buttressing
4. Tension band
5. Bridging

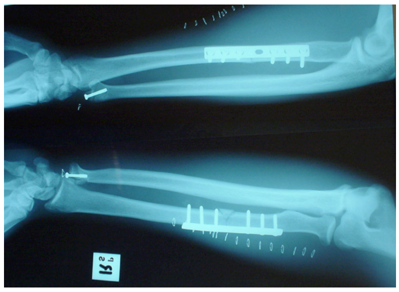
Neutralization or Protection Plate

Absolute Stability. A simple, torsion, or butterfly fracture of the diaphysis or metaphysis, caused by indirect rotational forces, is best reduced anatomically and fixed by one or two lag screws providing interfragmentary compression. It is normally recommended to protect the lag screw **fixation** with the addition of a plate in order to protect it or to neutralize any shearing or rotational forces, thereby improving the stability

Compression Plate.

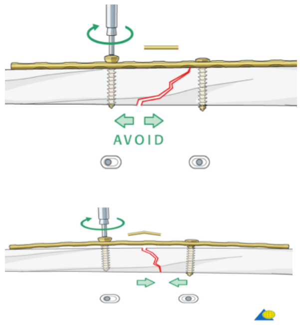
Axial compression of a transverse fracture of a forearm bone is best obtained by a compression plate.

By slightly overbending the plate in relation the shape of the bone and by eccentric placement of the screws, axial compression is obtained.



In short oblique fractures, in addition to axial compression, a lag screw inserted through the plate and across the oblique fracture plane will significantly increase the stability of the **fixation.**

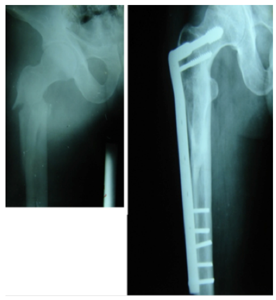
In oblique fractures, the plate is fixed first to the fragment with an obtuse angle, so that when compression is added on the opposite side of the fracture, the fragment locks in the axilla between plate and bone. To avoid distraction at distal cortex, overbending by 5 degrees is recommended



Tension Band Plate

The studies of Pauwels revealed that, with weight-bearing, the concave, medial side of the femur is undergoing compressive forces, while the convex, lateral cortex is under tension.

An eccentrically applied plate on the convex side of the bone will theoretically convert tensile forces into compression, provided the opposite medial cortex is stable.



Bridge Plate.

Since the introduction of more biological indirect reduction and minimally invasive techniques with less rigid or elastic fixations providing relative stability, a plate can also be applied as an **internal** bridging device, similar to an external fixator.

The best indications for bridge plating are comminuted diaphyseal or metaphyseal fractures that are not suited for intramedullary nailing. It is recommended to choose a plate about three times as long as the fracture zone and to fix it with only a few firmly anchored screws proximally and distally.

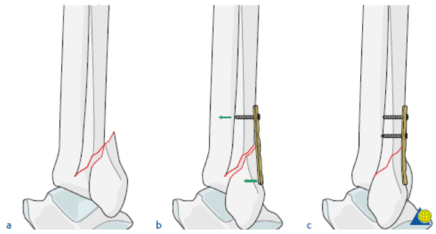
Antiglide plate

A buttress plate or antiglide plate has the function of preventing any secondary displacement of an oblique fracture in the metaphysis of a bone.

The different steps and the sequence of introducing the screws Proximal fragment first.

Buttress plates are often combined with lag screws either through the plate or independently

Useful: Medial and lateral malleoli; distal radius and proximal tibia



The example shows the application in a malleolar fracture, where the plate is positioned on the posterolateral aspect of the distal fibula.

Minimally Invasive Plate Fixation

Mast described in detail the advantages of indirect reduction techniques without exposing the fracture fragments and created the term of "biological plate **fixation**" with long bridging angle blade or straight plates.

The minimally plating group, the time for union was shorter and predictable even without bone graft, the complication rate was lower, and the functional outcome better.

Krettek Short incisions far away from the fracture focus and by inserting extra long plates via a bluntly prepared submuscular space close to the bone and across the fracture. In cadaver studies, Farouk could show that the perforator vessels were not injured by these tunneling maneuvers.

Similar to the rapid appearance of callus in intramedullary nailing, the healing of these minimally exposed fractures fixed with only relatively stable bridge plates occurred very consistently with early callus formation. The drawback of minimally invasive techniques is the higher incidence of axial and rotational malalignment. Furthermore, the intraoperative radiation exposure of the patient and staff is higher, but may be reduced when navigation techniques are refined and used more in the future.

Minimal Invasive Fixation

- Untouched fracture exposure
- Indirect reduction [fracture is reduced on to the plate]
- Epiperiosteal dissection
- Anatomic alignment than reduction
- Stable but not rigid fixation
- Healing by callus formation

Commonly used in: Distal tibia, Proximal tibia, Femur and Humerus